

Bus Signage For Persons With Visual Impairments: Light-emitting Diode (LED) Signs

PROBLEM Public transit systems are especially important to persons with visual impairments since their reduced visual capabilities may make driving impossible.

Transit authority operators have discovered that the unique characteristics of LED destination signage provided both on and in transit vehicles, while meeting the requirements for character size, illumination, etc., contained in *Title 49, Code of Federal Regulations; Part 38 Americans With Disabilities Act (ADA) Accessibility Specifications for Transportation Vehicles*, may none-the-less be hard to read under day, night, and low-light conditions by persons with visual impairments. Not having access to this information can make the use of public transportation difficult and, in some instances, dangerous.

APPROACH The Federal Transit Administration contracted a study to gather data on electronic sign characteristics that affect readability. The study involved:

- Conducting a detailed literature search of commercial, government, and Internet databases to identify relevant past research efforts.
- Soliciting questionnaire responses from transit authorities and transit users.
- Preparing and conducting human factors testing.

The study results recommended best practices for LED signs on transit vehicles specifically to accommodate persons with visual impairments.

RESULTS The study considered these factors to be important for readability:

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| • Letter height | • Luminance contrast percentage | • Message dynamics |
| • Letter width-to-height ratio | • Inter-character spacing | • Message dynamic display time |
| • Stroke width-to-height ratio | • Inter-word spacing | • Sign placement on vehicle |
| • Text color | • Inter-line spacing | • Glare and fog abatement |
| • Luminance | • Character case | • Visual clutter abatement |
| • Cleanliness | • LED Maintenance | • Vehicle Motion |

The results capture the most current understanding of and application of human factors principles to LED signage for the presentation of route and destination information on public transit vehicles. Consideration of these factors should help transit agencies choose LED transit sign systems that will improve accessibility to all patrons. For more detailed information contact:

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Recommended Best Practices	Discussion
Letter Height	
<p>Front sign not less than 8 inches</p> <p>Side sign not less than 5 inches</p>	<ul style="list-style-type: none"> Literature and research indicate larger letters on front signs (even as large as 10 inches or more) provide better viewing for persons with visual impairments. This recommendation and actual letter size may be limited by the current sign technology and the space provided on the vehicle for sign placement. Literature and research indicate larger letters on side signs (even as large as 6 inches or more) provide better viewing for persons with visual impairments. Viewing distance is limited by extreme visual angles associated with reading the side-signs.
Letter Width-to-Height Ratio	
<p>5:7 to 1:1</p>	<ul style="list-style-type: none"> Research indicates that the more legible ratios are slightly larger than the minimum 3:5 width-to-height required by ADA Accessibility Guidelines (ADAAG) and that legibility tends to decrease as the ratio approaches the maximum 1:1 width-to-height permitted under ADAAG.
Stroke Width-to-Height Ratio	
<p>Not less than 1:5</p>	<ul style="list-style-type: none"> There is general (but not complete) agreement on values in and around this range for application to text readability.
Text Color	
<p>Amber/Yellow</p>	<ul style="list-style-type: none"> Literature and current research appear to indicate a general advantage for colors from the middle of the visual light spectrum (~ 570 – 590 nm wavelengths) across all environmental lighting conditions. Some study results appear to indicate a shift to the longer wavelengths (e.g., green and blue) provides adequate legibility under lower lighting and night conditions.
Luminance	
<p>Night 30cd/m² Day >1,000cd/m²</p>	<ul style="list-style-type: none"> Existing research on this variable is fairly strong for individuals without vision impairments.
Luminance Contrast Percentage	
<p>$[(L_c - L_b) / L_b] \times 100 \geq 70\%$</p>	<ul style="list-style-type: none"> Where: L_c = Luminance (brightness) of characters; L_b = Luminance (brightness) of background. Existing research on this variable is strong for individuals without vision impairments. Additional research should be conducted to determine if these levels are sufficient for individuals with vision impairments.
Inter-character Spacing	
<p>1.5 to 2.0 times stroke width</p>	<ul style="list-style-type: none"> Research supports significantly wider spacing than that provided by the ADAAG.
Inter-word spacing	
<p>75-100% letter height</p>	<ul style="list-style-type: none"> Existing research on this variable is strong but available sign space, especially for longer destination/route messages, may be a limiting factor.
Inter-line spacing	
<p>50 to 75% of letter height</p>	<ul style="list-style-type: none"> Existing research on this variable is strong but available sign space may result in letters that are significantly smaller than the recommended 8 inches height.
Case	
<p>Uppercase</p>	<ul style="list-style-type: none"> Neither the literature review nor the current research present any evidence that lower case LED messages are more legible to persons with visual impairments in any of the research conditions here.
Message Dynamics	
<p>Static</p>	<ul style="list-style-type: none"> Where possible, complete route/destination messages should be presented in static (i.e., not moving) format.
Message Dynamic Display Time	
<p>2.7 - 10 seconds</p>	<ul style="list-style-type: none"> Research is not adequate to indicate the relative advantages and tradeoffs of display times for dynamic messages (e.g., streaming, paging).
Sign Placement on Vehicle	
<p>Front</p> <p>Side</p>	<ul style="list-style-type: none"> Sign should be placed above the windscreen or as low as practicable within the windscreen area (noting influence of glare on sign legibility), above the driver's field of view. Sign should be placed on side of vehicle, adjacent to the entrance that is closest to the front of the vehicle at a height of not less than 4 ft. to the lower edge of the display characters and not more than 8 ft. to the upper edge of the display characters measured from the ground.